Space Weather Technical Forecast

Issued on Wednesday, 30 March 2022 at 01:12 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of further M-class flares throughout. Slight chance of further S1 or above solar radiation storms. G1-G2/Minor-Moderate geomagnetic storms are expected on Days 2 and 3 (31 March and 1st April), with a Chance of a G3/Strong storm.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity continues at Moderate levels, with several M-class flares through the UTC day, the largest an M2 flare at 29/0111 UTC. These all originated from AR2975. There are currently five visible numbered sunspot regions on the Earth facing disc. AR2975 (NW quadrant) remains magnetically complex and continues to develop, with some coalescence of some of the smaller intermediate spots, and the continued presence of two delta spots. AR2976 also in the northeast quadrant is currently the largest sunspot, although remains stable. AR2978 (Eho/Beta) continues to rotate across the SE quadrant. The large lead spot unchanged, with some waxing/waning of small intermediate spots. AR2974 (SW quadrant) remains a small, simple uni-polar spot. AR2980 is currently a small bi-polar group in the northwest quadrant.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was mainly between 430-400km/s. The density has been at average levels. The strength of the IMF, Bt, has been at weak at 2-5nT. The north-south component, Bz, weakly variable mainly between +/-4 nT. The Phi angle was predominately positive (away from the Sun), but with brief transitions to negative (towards the Sun). Geomagnetic activity was mostly Quiet (Kp 1-2), with BGS showing isolated Unsettled (Kp 3) activity.

Energetic Particles / Solar Radiation: The high energy proton flux (10MeV) measured at GOES-16 continued a slow decline following the S1/Minor solar radiation storm on 28th March. The high energy (greater than 2 MeV) electron flux as observed by GOES-16 at GEO was at background to moderate levels, with a peak of 570pfu at 29/1720 UTC. The observed fluence at 30/0000 UTC was 9.26e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mostly Low, but with the chance of further M-class flares, mainly from AR2975.

Solar Wind / Geomagnetic Activity: The next enhancement is expected to come from the 28th March CME(s), which are anticipated to arrive, as a combined CME at Earth on Day 2 (31 March). CME effects are then expected to continue into Day 3 (1st April), before gradually weakening into Day 4.

Quiet to Unsettled conditions are expected until Day 2 (31st Mar), when Active to G1-G2/Minor-Moderate storm periods are expected, with the Chance (30%) of a G3/Strong Storm, and perhaps a Slight Chance (10%) of a G4/Severe Storm. Disturbed geomagnetic conditions are expected to continue into Day 3 (1st April), before gradually easing into Day 4.

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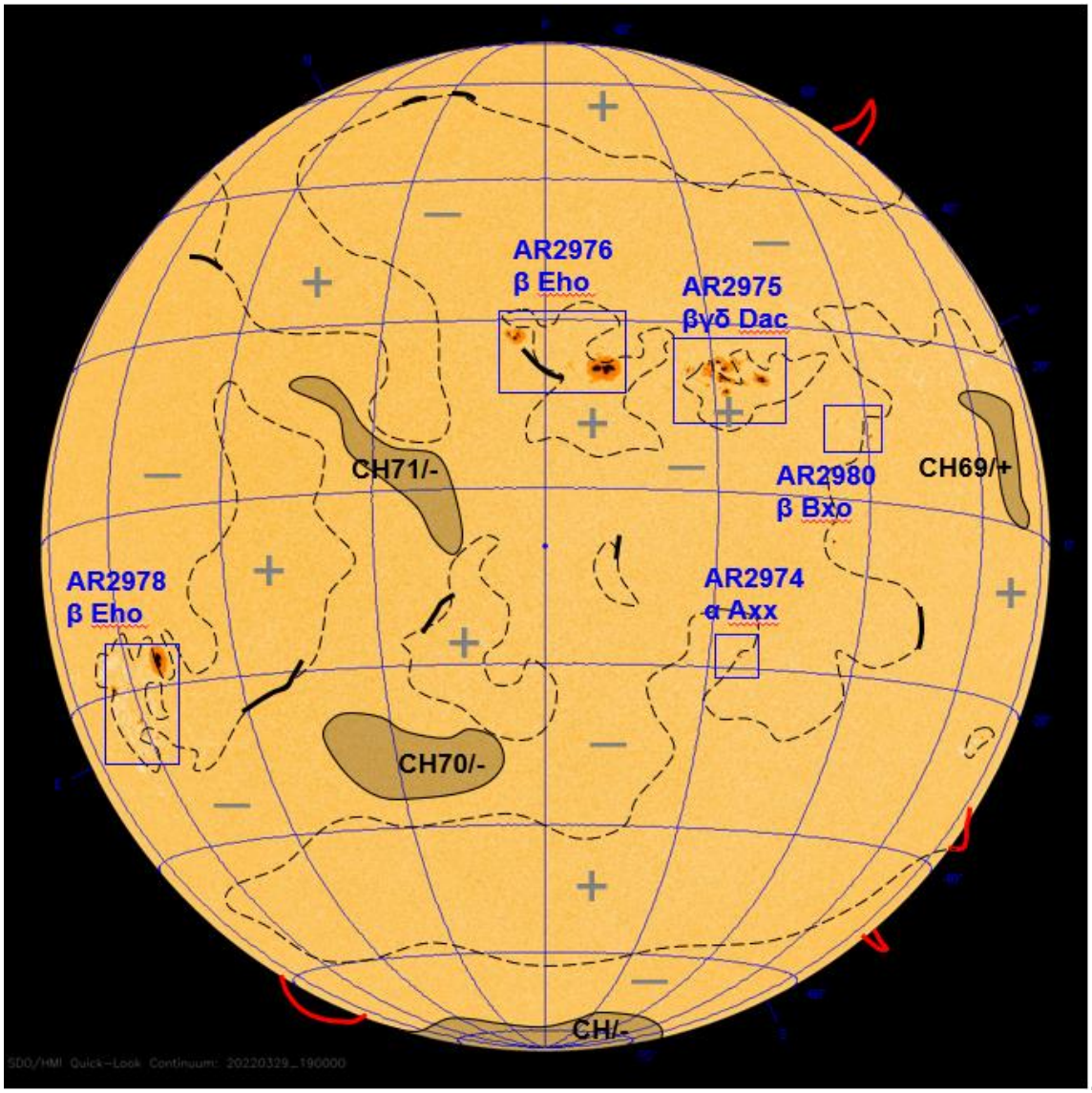
Energetic Particles / Solar Radiation: The continued activity of AR2975 in particular gives the slight chance of further potential enhancements above the S1 threshold during the period.
A flat trend is expected at first in the high energy (greater than 2MeV) electron flux. However, from Day 2 (31st March) confidence becomes low, as the 28th March CME(s) are expected to arrive at Earth, and this is likely to at least temporarily reduce flux levels. Thereafter, some erratic fluctuation is likely, but with a possible eventual rise towards the end of the period. The associated 24 hour fluence is likely to remain below the Active (1e8 integrated pfu) threshold for much of the period.

Figure 1. Solar Analysis Valid 29/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar wind speeds have been at slightly elevated levels, mainly between 430-400km/s. The next enhancement is expected to come from the 28th March CME(s), which are anticipated to arrive, as a combined CME at Earth on Day 2 (31 March). CME effects are then expected to continue into Day 3 (1st April), before gradually weakening into Day 4.

Quiet to Unsettled conditions are expected until Day 2 (31st Mar), when Active to G1-G2/Minor-Moderate storm periods are expected, with the Chance (30%) of a G3/Strong Storm, and perhaps a Slight Chance (10%) of a G4/Severe Storm. Disturbed geomagnetic conditions are expected to continue into Day 3 (1st April), before gradually easing into Day 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	80	60	10
Strong	G3	No	1	30	30	1
Severe	G4	No	1	10	10	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
28/1624 UTC	Halo	M4 flare 28/1129 UTC	AR2975	550	31st March	G1-G2 expected, with a Chance of G3
29/0108 UTC	Halo	M1 flare 28/1920 UTC	AR2975	722	31st March	Combines with the above CME

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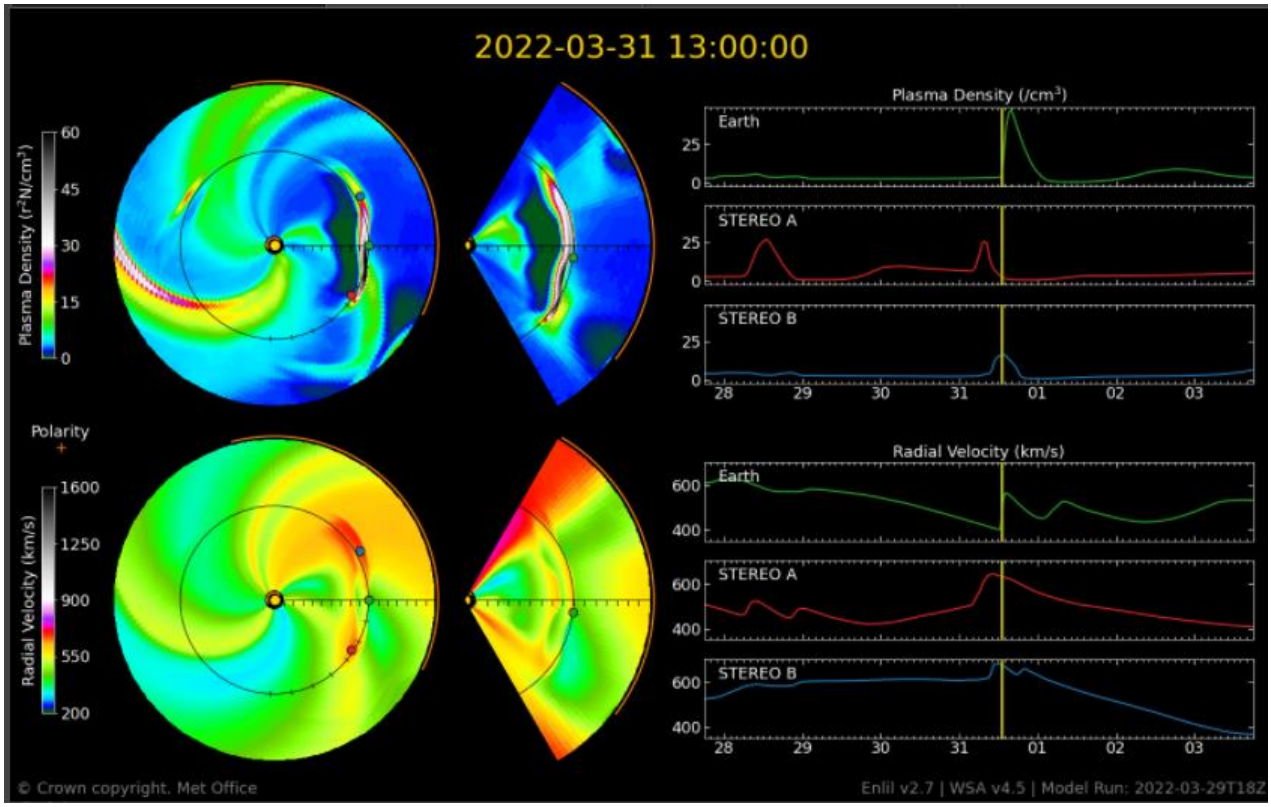
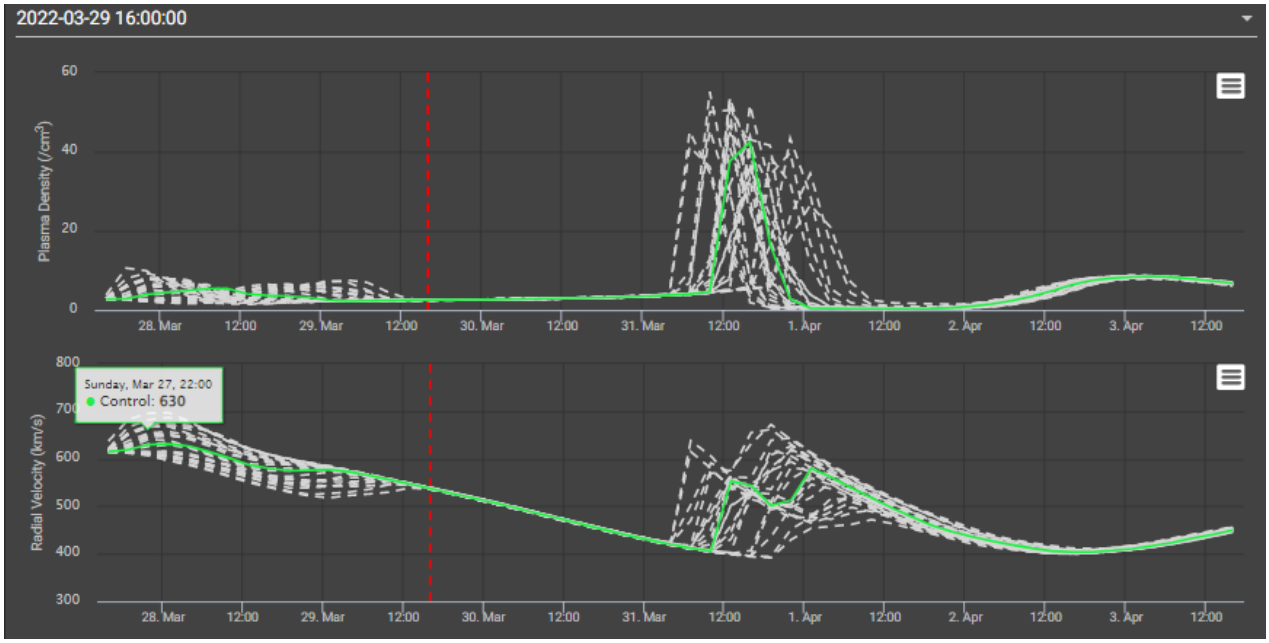
Figure 2: Enlil (top) showing the combined 28th March CMEs arrival at Earth on Day 2 (31st March). Ensemble (below) showing the spread in potential CME arrival times on 31st March.




2022-03-29 16:00:00
Plasma Density (/cm³)
Radial Velocity (km/s)
Sunday, Mar 27, 22:00
Control: 630
28. Mar 12:00 29. Mar 12:00 30. Mar 12:00 31. Mar 12:00 1. Apr 12:00 2. Apr 12:00 3. Apr 12:00

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Radio Blackouts - X-Ray Flares:

Solar activity continues at Moderate levels, with several M-class flares through the UTC day, the largest an M2 flare at 29/0111 UTC. These all originated from AR2975.

There are currently five visible numbered sunspot regions on the Earth facing disc. AR2975 (NW quadrant) remains magnetically complex and continues to develop, with some coalescence of some of the smaller intermediate spots, and the continued presence of two delta spots. AR2976 also in the northeast quadrant is currently the largest sunspot, although remains stable. AR2978 (Eho/Beta) continues to rotate across the SE quadrant. The large lead spot unchanged, with some waxing/waning of small intermediate spots. AR2977 (NW quadrant) has now decayed. AR2974 (SW quadrant) remains a small, simple uni-polar spot. AR2980 is currently a small bi-polar group in the northwest quadrant.

Solar activity is expected to be mostly Low, but with the chance of further M-class flares, mainly from AR2975.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	10	10	10	10

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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES-16 continued a slow decline following the S1/Minor radiation storm on 28th March. The continued activity of AR2975 in particular gives the slight chance of further potential enhancements above the S1 threshold during the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux, as observed by GOES-16 at GEO, was at background to moderate levels, with a peak of 570pfu at 29/1720 UTC. A flat trend is expected at first. However, from Day 2 (31st March) confidence becomes low, as the 28th March CME(s) are expected to arrive at Earth, and this is likely to at least temporarily reduce flux levels. Thereafter, some erratic fluctuation is likely, but with a possible eventual rise towards the end of the period.

The 24 hour fluence is likely to remain below the Active (1e8 integrated pfu) threshold for much of the period. REFM is considered to be giving reasonable guidance in the short term with a flat trend, but will not reflect the anticipated CME influences from Day 2 (31st).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	10	20	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

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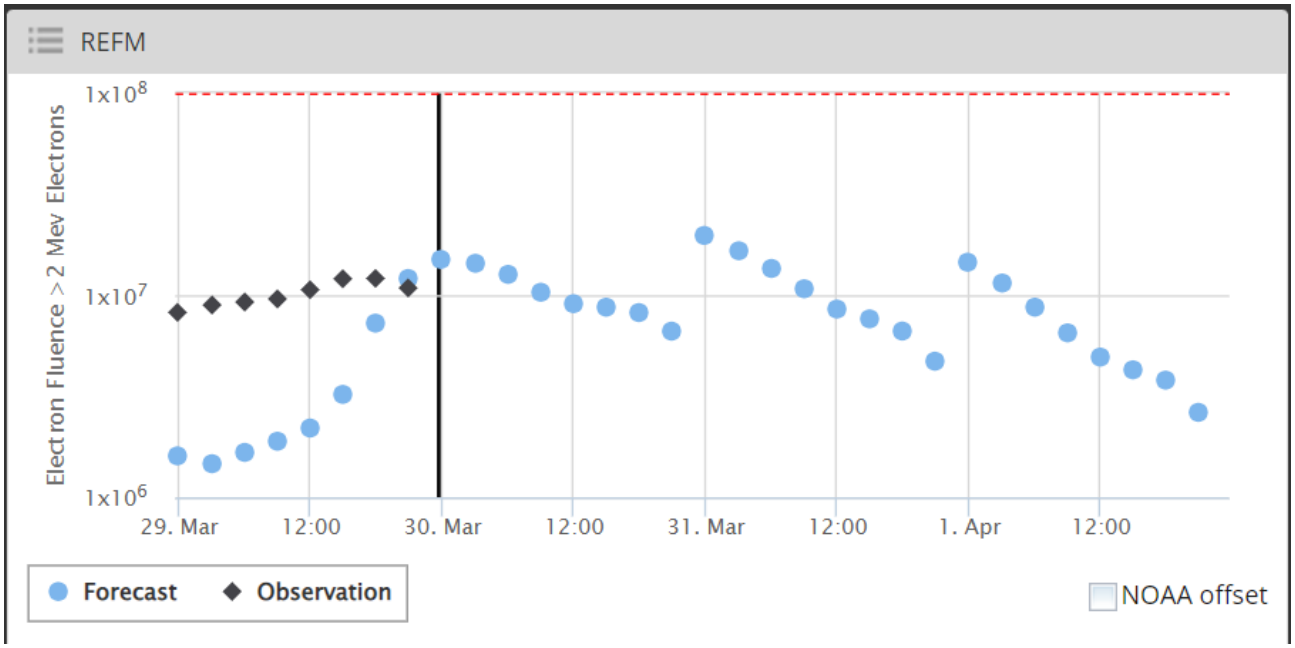
Figure 3: MOSWOC REFM. Good guidance for Day 1 (30th March), but will not reflect CME influences from Day 2 (31st March).



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